HATCHERY AND GENETIC MANAGEMENT PLAN (HGMP)

Washington Department Fish and Wildlife

SECTION 1. GENERAL PROGRAM DESCRIPTION

1.1) Name of Program

Upper Columbia Summer Chinook Salmon Mitigation and Supplementation Program- Eastbank (Rocky Reach and Rock Island Settlement Agreements) and Wells (Wells Settlement Agreement) Fish Hatchery Complexes.

1.2) Population (or stock) and species

Upper Columbia River Summer- and Fall-run ESU chinook salmon (*Oncorhynchus tshawytscha*); summer-run component upstream of Priest Rapids Dam.

1.3) Responsible organization and individual:

Name(and title): Washington Department Fish and Wildlife
Organization:
Address: 600 Capitol Way North, Olympia, WA 98501-1091
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Other organizations involved, and extent of involvement in the program:

The summer chinook salmon run size enhancement program is funded by Public Utility District (PUD) No. 1 of Chelan County and PUD No. 1 of Douglas County for the purpose of mitigation for lost fish production as a result of fish mortality at the Rock Island, Rocky Reach, and Wells hydroelectric projects. The program is consistent with the Mid-Columbia Mainstem Conservation Plan ("MCMCP" - BAMP 1998), and the parties to this plan are involved in short and long-term production planning.

1.4) Location(s) of hatchery and associated facilities:

Broodstock Capture: Wells Dam Trap - located on the mainstem Columbia River (WRIA 48-0001), Washington at Rkm 861.0; Dryden Dam Traps - located on the Wenatchee River (WRIA 45-0030), Washington at Rkm 25.8; and Tumwater Dam Trap - located on the Wenatchee River (WRIA 45-0030) at Rkm 52.0.

Broodstock Holding to Maturity: Wells Hatchery - located on the mainstem Columbia

River (WRIA 48-0001), Washington at Rkm 861.0; and Eastbank Hatchery, Columbia River Basin, Washington - located on the east side of the Columbia River near Rocky Reach Dam, 7 miles north of Wenatchee, Washington.

Fish Spawning, Incubation, Rearing: Spawning: Wells Hatchery - located on the mainstem Columbia River (WRIA 48-0001), Washington at Rkm 861.0; and Eastbank Hatchery, Columbia River Basin, Washington - located on the east side of the Columbia River near Rocky Reach Dam, 7 miles north of Wenatchee, Washington. Incubation*:* Eastbank Hatchery and Wells Hatchery. Rearing*:* Eastbank Hatchery; Wells Hatchery; and Rocky Reach Hatchery, located on the Columbia River adjacent to the tailrace of Rocky Reach Dam at Rkm 790 on the Columbia.

Rearing to release: Carlton Pond, located on the Methow River (WRIA 48-0007)at Rkm 59, near Twisp, Washington; Similkameen Pond, located on the Similkameen River (WRIA 49-0325) at Rkm 5, near Oroville, Washington; Dryden Pond, located on the Wenatchee River, Washington (WRIA 45-0030) at Rkm 26.0; Turtle Rock Hatchery, located on Turtle Rock Island 3 km upstream of Rocky Reach Dam at Rkm 793 on the Columbia River; and Wells Hatchery.

1.5) Type of program:

The summer chinook salmon supplementation projects operated and managed by WDFW in the upper Columbia River region are "integrated harvest" programs.

1.6) Purpose (Goal) of program:

The goal of the regional summer chinook artificial propagation programs is to mitigate for the loss of summer chinook salmon adults that would have been produced in the region in the absence of Wells, Rocky Reach, and Rock Island hydroelectric projects. This goal can be met through the use of the artificial environment of fish rearing facilities to increase the number of adults that return to the basin by increasing survival at life-history stages where competitive or environmental bottlenecks occur. Concurrently, a release strategy for artificial production is employed that will not create a new bottleneck in productivity through competition with the naturally produced component of the population and other naturally produced stocks.

1.7) Specific performance objective(s) of program:

(1) increase hatchery production incrementally over several salmon generations, while closely monitoring the distribution, demographics, and abundance of natural fish in the region,
(2) determine the levels of hatchery production that are consistent with the objective of maintaining sustainable natural productivity using criteria set forth in the MCMCP (BAMP 1998),
(3) defer increases in hatchery production if the natural escapement is not increasing in proportion to the total run,
(4) gradually transfer releases from the mainstem Columbia River to the tributaries, (5) use release strategies that minimize impacts to juvenile natural fish, and (6) provide for

overwinter acclimation to release sites, if possible.

1.8) List of Performance Indicators designated by "benefits" and "risks":

Benefits:

(1) an enhanced post-release smolt-to-adult survival rate of hatchery-reared juvenile summer chinook salmon, evaluated through fishery contribution, trap recovery, and extensive spawning surveys;
(2) trapping of sufficient broodstock to meet programmed release numbers;
(3) use of fish cultural methods which maintain the genetic integrity of the natural stock; &
(4) use of fish cultural methods which lead to the release of high quality smolts.

Risks:

(1) the overall ESU for summer chinook salmon appears to be at low risk of extinction, thereby not requiring extensive hatchery intervention to increase the viability of natural spawners (although some populations in that ESU may be at higher risk than others, and may subsequently warrant supplementation); (2) additional collections of natural adults for broodstock (particularly for the sub-yearling release programs) may present a risk to the natural donor populations; (3) the potential for long-term genetic deterioration is accentuated by a high proportion of hatchery fish in the populations, the indefinite nature of the programs, the fact that all populations within the ESU are being supplemented, and the relatively long residence time of yearling-reared fish produced in the hatchery; and (5) the high proportion of hatchery fish on the spawning grounds makes it difficult to accurately assess the health of the natural populations.

1.9) Expected size of program:

Expected releases:

The current and future, expected size of the WDFW summer chinook hatchery program (fish production by facility) is indicated in Table 1 (from BAMP 1998). Future increases or changes in the number, age class, and release location of summer chinook salmon produced each year through the WDFW programs are proposed within the MCMCP "Mid-Columbia Hatchery Plan" (BAMP 1998). These increases or changes will be based on the results of hatchery fish survival analyses, and ecological and genetic interaction studies of the effects of the programs on natural fish.

Adult fish produced/harvested:

Annual escapement of summer chinook salmon to Rock Island Dam averaged 15,640 adults and jacks (1983-

92 data from Chapman 1994). Hatchery-origin adults are estimated to have contributed part of the escapement levels to the region, averaging about 6% of the total escapement for the years 1967-87 (Chapman et al. 1995).

Table 1. Summer chinook salmon smolt production objectives for upper Columbia WDFW hatcheries.

		Current production objective		Future production objective	
Stock	Facility	Number	pounds	Number	pounds
Wenatchee	Dryden	864,000	86,400	864,000	86,400
	Plain	0	0	750,000	75,000
Methow	Carlton	400,000	40,000	520,000	52,000
Okanogan	Similkameen	576,000	57,600	576,000	57,600
Wells	Wells FH	320,000	32,000	320,000	32,000
		484,000	24,200	484,000	24,200
Wells	Chief Joseph	0	0	300,000	30,000
Wells	Rocky Reach	200,000	20,000	0a	0
		1,620,000	32,400	0	0
Totals		4,464,000	292,600	5,634,000	409,600

[a] *Current production and releases at the Rocky Reach FH/Turtle Rock facilities will be maintained at current levels for the near future. After analyses of the relative risks of yearling and sub-yearling release strategies to natural production, these facilities may be used for incubation and initial rearing only. Fish may be transferred to acclimation sites for final rearing and release.*

Smolt to adult survival rates for summer/fall chinook produced in WDFW hatchery programs within the region have been estimated to range from 0.07 % to 3.62 %, averaging 1.49 % (smolt to adult overall survival estimates for brood year 1982-87 for Rocky Reach Hatchery releases from Chapman et al. 1994). Table 2 presents estimated survival rates for WDFW summer and fall chinook sub-yearling and yearling smolt releases presented in the Mid-Columbia Hatchery Plan (BAMP 1998):

Table 2. Release-to-adult survival rates of summer and fall chinook salmon reared as sub-yearlings and yearlings at selected hatcheries in the Mid-Columbia Region. Survival rates are expressed as unweighted means of variable-sized release groups.

Hatchery	Age at release	Release years	Release-to-adult survival rate (%)
Priest Rapids	sub-yearling	1976 - 1989	0.835
Rocky Reach	yearling	1984 - 1989	1.366
Wells	sub-yearling	1976 - 1989	0.098
Wells	yearling	1976 - 1989	0.410

Estimated total fishery harvest rates for summer chinook returning to the region average 68 %

(1982-89 brood year data from PSC 1984), although this rate may be over-estimated due to incomplete accounting of escapement (Myers et al. 1998).

Escapement goal:
Chapman et al. (1994) proposed an escapement objective to basin tributaries above Wells Dam of 3,500; a level carried forth in the "Mid-Columbia Hatchery Plan" as a natural escapement goal (BAMP). A baseline adult production objective for the summer chinook salmon population reaching Rocky Reach Dam is 30,293 (BAMP 1998). The brood year 1995 broodstock collection goals for the WDFW programs were 453 adults for the Wenatchee system and 641 fish for the Wells Dam program (Petersen et al. 1999).

1.10) Date program started or is expected to start:

Hatchery production of summer chinook in the region has been continuous since implementation of the Grand Coulee Fish Maintenance Project (GCFMP), with several USFWS hatcheries constructed beginning in 1941 on the Wenatchee, Entiat, and Methow Rivers (Waknitz et al. 1995). The WDFW hatcheries currently producing summer chinook smolts were constructed in the mid-1960s (Turtle Rock), 1967 (Wells), 1989 (Eastbank), and 1990 (Similkameen Pond, Dryden Pond, and Carlton Pond).

1.11) Expected duration of program:

The supplementation program will continue with the objective of mitigating for the loss of summer chinook salmon productivity caused by hydroelectric dams in the Columbia River Basin; in particular the Rock Island, Rocky Reach, and Wells hydroelectric projects.

1.12) Watersheds targeted by program:

Summer chinook salmon propagated and released through the Wenatchee River and Methow/Okanogan river (Wells) supplementation programs originated from natural and hatchery-origin broodstock returning to those systems. The targeted watersheds are tributary to the upper Columbia River (WRIA 48-0001). The Wells and Rocky Reach enhancement programs are not specifically designed and operated to achieve supplementation objectives, although returning summer chinook are known to contribute to hatchery broodstocks and to natural escapement of the larger, homogenous summer/fall chinook ESU.

SECTION 2. RELATIONSHIP OF PROGRAM TO OTHER MANAGEMENT OBJECTIVES

2.1) List all existing cooperative agreements, memoranda of understanding, memoranda of agreement, or other management plans or court orders under which program operates. Indicate whether this HGMP is consistent with these plans and commitments, and explain any discrepancies.

The supplementation program, and the HGMP describing it, are consistent with the following agreements or plans:

- The Mid-Columbia Mainstem Conservation Plan - Hatchery Plan (BAMP 1998).
- The Rock Island Settlement Agreement (RISA 1989) between Chelan Public Utilities District, their power purchasers, and the joint fishery parties represented by Washington Department of fish and Wildlife and other state and federal fishery agencies and tribes.
- The Wells Settlement Agreement between Douglas PUD, their power purchasers, and the joint fishery parties represented by Washington Department of fish and Wildlife and other state and federal fishery agencies and tribes.
- Section 10 incidental take permit # 902, originally issued to WDFW by NMFS on April 8, 1994, and amended December 30, 1998.
- The Rocky Reach Mitigation Agreement between the joint fishery parties and Chelan PUD, as modified in the late-1980s.

2.2) Status of natural populations in target area.

Summer chinook salmon (target populations) -

The natural populations targeted for supplementation include summer chinook spawning in the Wenatchee, Methow, and Okanogan rivers. The Methow and Okanogan river stocks are considered depressed based on negative escapement trends (WDF and WDW 1993). The Wenatchee stock is considered healthy due to a relatively stable escapement level (WDF and WDW 1993). The 1979-91 average run to the rivers for these stocks was about 10,100 (WDF and WDW 1993). The long term abundance trend based on total escapement for the Wenatchee stock is almost flat (-0.1 % per year), with a short term trend of -8.9 % per year (Myers et al. 1998). Long term trends for the Methow and Okanogan populations are -5.4 % and -5.2 % respectively, and 0.6 % and -8.8 % on the short term (1987-96) (Myers et al. 1998).

WDF et al. (1993) classified Upper Columbia natural summer chinook as of native or mixed origin and wild production. In the 1997 "Status Review of Chinook Salmon from Washington, Idaho, Oregon, and California", NMFS indicated that summer/fall chinook salmon in this ESU were not in danger of extinction, nor were they likely to become so in the foreseeable future (Myers et al.1998).

Other salmonid species -

Several salmonid species in the target area are listed as "endangered" or "threatened" under the ESA. Upper Columbia River ESU steelhead and Upper Columbia River ESU spring chinook are listed as "endangered", and Columbia River population segment bull trout are listed as "threatened". Sockeye salmon in the region were judged as neither in danger of extinction or likely to become so in the foreseeable future by NMFS in the west coast sockeye salmon species status review (Gustafson et al. 1997). Other ESA-listed species of significance to the

summer chinook programs include those that originate in other watersheds within the Columbia River Basin: Middle Columbia River ESU steelhead - "threatened"; Snake River ESU sockeye - "endangered"; Snake River ESU spring chinook - "threatened"; Snake River ESU fall chinook - "threatened"; Snake River ESU steelhead - "threatened"; Lower Columbia River ESU chinook - "threatened"; Lower Columbia River ESU chum - "threatened"; Lower Columbia River ESU steelhead - "threatened"; and Lower Columbia/Southwest Washington ESU coastal cutthroat - "threatened".

2.2.1) Geographic and temporal spawning distribution.

Summer chinook salmon returning to the region spawn primarily in the Wenatchee River, with smaller spawning populations in the Methow, Similkameen, and Okanogan rivers. Summer chinook adults enter freshwater from mid-June through late-August (Wenatchee and Methow stocks) or mid September (Okanogan population) (WDF and WDW 1993). Wenatchee and Methow summer chinook spawning begins in late September and ends in early to mid-November, with peak spawning in October (Chapman et al. 1994; WDF and WDW 1993). Okanogan summer chinook begin spawning about one week earlier than the Wenatchee and Methow fish, but exhibit the same end and peak spawn timings (Chapman et al. 1994).

Summer/fall chinook typically spawn in the Wenatchee River between Rkm 1.7 and Rkm 90; in the Methow River between Rkm 3.3 and Rkm 86; in the Okanogan River between Rkm 24.2 - 129 and in the Similkameen River from Rkm 0 to 14.8 (Chapman et al. 1994).

2.2.2) Annual spawning abundance for as many years as available.

Table 3. Upper Columbia natural summer chinook spawning escapement estimates (return years1979-1991 from WDF and WDW 1993).

Return Year	Wenatchee River	Methow River	Okanogan Basin
1979	12,623	2,775	1,293
1980	8,995	1,538	1,252
1981	4,515	868	778
1982	4,113	632	363
1983	3,937	288	400
1984	8,420	722	2,300
1985	9,185	732	1,941
1986	10,021	753	2,158
1987	9,831	778	1,246
1988	10,389	440	989

Return Year	Wenatchee River	Methow River	Okanogan Basin
1989	12,764	561	1,717
1990	9,343	1,268	729
1991	7,144	474	481

2.2.3) Progeny-to-parent ratios, survival data by life-stage, or other measures of productivity for as many brood years as available.

Progeny to parent survival rates:

Smolt to adult survival rates for summer chinook produced in the WDFW programs in the recent years has ranged from 0.07 % to 3.62 %, averaging 1.49 % (smolt to adult overall survival estimates for brood year 1982-87 for Rocky Reach Hatchery releases from Chapman et al. 1994). Table 4 presents survival data by life stage for the Wenatchee and Methow/Okanogan summer chinook programs (data from Eltrich et al. 1995; Petersen et al. 1997; Petersen et al. 1999a; and Petersen et al. 1999b).

Table 4. Wenatchee and Methow/Okanogan summer chinook program survival summary by life stage (1989-1993 brood years).

Percent survival by life stage		Brood Year				
		1991	1992	1993	1994	1995
Adult (holding)	**Wenatchee**	90.7	85.7	95.4	94.5	94.7
	Methow/Okanogan	92.4	95.0	83.7	83.1	89.3
Egg	**Wenatchee**	86.9	79.7	81.7	83.7	86.0
	Methow/Okanogan	88.2	87.0	83.0	86.6	82.3
Fry	**Wenatchee**	96.6	97.8	99.6	99.2	96.7
	Methow/Okanogan	97.1	98.0	99.8	98.1	96.5
Rearing	**Wenatchee**	95.7	97.2	98.1	92.3	71.3
	Methow/Okanogan	98.4	95.5	99.5	70.6	89.0
Overall (fertilization to release)						
	Wenatchee	**80.3**	**75.5**	**79.4**	**79.8**	**64.4**
	Methow/Okanogan	**84.2**	**78.2**	**76.7**	**63.3**	**76.6**

2.2.4) Annual proportions of hatchery and natural fish on natural spawning grounds for as many years as possible.

Chapman et al (1994), quoting Mullan (1990), estimated a mean hatchery-origin summer chinook contribution rate of about 6 % of the total run reaching Rock Island Dam for return years 1967-87. However, Myers et al. (1998), quoting Miller et al. 1990, reported that because of large releases of ocean-type chinook salmon in the mainstem Columbia River and the Yakima River in recent years, a substantial portion (approximately 50 %) of the adults returning to the Upper Columbia summer/fall chinook ESU appear to be of hatchery-origin.

2.2.5) Status of natural population relative to critical and viable population thresholds.

The natural summer chinook salmon populations in the upper Columbia Basin are healthy (Wenatchee River) or depressed (Methow River and Okanogan Basin) in status (WDF et and WDW 1993). The Upper Columbia River summer/fall chinook ESU including these populations has been judged as not warranting listing under ESA protective provisions (Myers et al. 1998).

2.3) Relationship to harvest objectives:

The summer chinook artificial propagation program is a component of the *Mid-Columbia Hatchery Program*, a part of an application for a 50-year multi-species Habitat Conservation Plan (HCP) and relicensing agreement for the PUDs. This plan has two objectives: (1) to help recover natural populations throughout the Mid-Columbia Region so that they can be self-sustaining and harvestable, while maintaining their genetic and ecologic integrity; and (2) to compensate for a 7% mortality rate at each of the five PUD-owned mid-Columbia River mainstem dams (Wells, Rocky Reach, Rock Island, Wanapum, and Priest Rapids) in a manner that is consistent with the first objective. Through the regional hatchery plan, the summer chinook artificial production program has been integrated with harvest management objectives to provide run size enhancement and fishery benefits. Biological risks to listed species in the Columbia Basin posed by hatchery chinook releases, including predation, competition, and disease transfer, are expected to be minimal.

Summer chinook from the region are only harvested incidentally in lower Columbia River fisheries directed at other species, and no directed commercial fisheries on upper Columbia summer-run fish have occurred in the mainstem since 1964 (BAMP 1998). Ceremonial and subsistence fisheries by the Colville Tribe in waters upstream of Rock Island Dam (mainly at the base of Chief Joseph Dam) harvest an average of 800 adults each year (1987-92 data from Chapman and al. 1994). The 1982-89 brood year average ocean fisheries exploitation rate is 39 %, with a total exploitation rate of 68 % estimated for the same years (Myers et al. 1998).

Estimation of recent, past harvest rates for summer chinook originating in the region is complicated by changes in timing of the adult return of the Wells Hatchery group. As a

consequence, Chapman et al. (1994) used only one brood year (1977) as the base for estimating preterminal exploitation rates for all subsequent brood years. The recent past (1975-87) mean exploitation rate for Wells Hatchery-origin summer chinook was estimated by Chapman et al (1994) to be about 40 %.

Given fishery protection measures implemented in preterminal area, mainstem Columbia River and upper river tributaries to protect ESA-listed and depressed salmonid populations, future harvest rates on fish propagated by the program and on natural populations in the target area are expected to be lower than the mean level (40 %) estimated for the 1975-87 period.

2.4) Relationship to habitat protection and recovery strategies.

Summer chinook salmon in the mid-Columbia Region are among the most electrophoretically homogenous populations in the state (BAMP 1998). The diversity of habitat they use however, is quite high. One goal of the summer chinook hatchery programs is to develop local adaptation to streams in the Mid-Columbia Region. Production methods are implemented that encourage local adaptation to the various habitats within the region while minimizing negative effects on natural fish populations. One goal of the Mid-Columbia Habitat Program is to protect and restore critical habitats for salmon and steelhead within the Mid-Columbia Region (Bugert et al. 1997). The "Mid-Columbia Hatchery Program" (BAMP 1998) on which the summer chinook release programs are based will therefore work in concert with that program. The main fresh-water habitat problem presently facing this ESU is presence of hydropower dams in the mainstem Columbia River, which have probably reduced returns of chinook salmon (Chapman et al. 1994). Measures taken by the Mid-Columbia PUDs to improve natural production of anadromous fish in the region will compensate for mortality in project and reservoir passage. Two strategies will be used: (1) habitat protection and restoration, and (2) hatchery production of affected species in the mainstem mid-Columbia River and in the four major tributaries (BAMP 1998).

Habitat protection efforts, combined with production from the summer chinook hatchery programs, are expected to benefit natural summer chinook production over the short-term and long- term. Improvements in dam passage survival rates, and improvements in smolt to adult survival rates afforded by the summer chinook programs will be used to boost the upper river adult population to a level approaching 18,000 fish at Priest Rapids Dam and approaching 8,000 at Rocky Reach Dam (BAMP 1998).

2.5) Ecological interactions

Salmonid and non-salmonid fishes or other species that could:
(1) negatively impact program;
Summer chinook smolts are released in the spring as either yearlings or sub-yearlings. Competition for food may play a role in the mortality of liberated summer chinook. SIWG (1984) indicated that there is a high risk that competition between hatchery-origin chinook, and

coho, steelhead and other chinook stocks, will have a negative impact on the productivity of the hatchery fish. Predation in freshwater areas also may limit the productivity of the summer chinook releases. In particular, predation by northern pike minnow poses a high risk of significant negative impact on productivity of enhanced chinook (SIWG 1984). Predation risks to hatchery chinook juveniles posed by coho, steelhead, and other chinook stocks are unknown (SIWG 1984). Hatchery-reared salmon and steelhead released into spawning and rearing areas of natural species may fail to emigrate (residualize), and may negatively interact with natural fish. Steelhead residualism has been found to vary greatly, but is thought to average between 5% and 10% of the number of fish released (USFWS 1994). Because of their larger size, the predation risk posed by the above species is lower to yearling smolts released from the hatcheries (Rieman et al. 1991).

(2) be negatively impacted by program;
SIWG (1984) reported that there is a high risk that enhanced chinook salmon populations would negatively affect the productivity of wild chum and sockeye in freshwater and during early marine residence through predation. The risk of negative effects to wild fish posed by hatchery chinook through competition is low or unknown in freshwater and marine areas (SIWG 1984). Large concentrations of migrating hatchery fish may attract predators (birds, fish, and seals) and consequently contribute indirectly to predation of listed wild fish (Steward and Bjornn 1990). The presence of large numbers of hatchery fish may also alter wild salmonid behavioral patterns, potentially influencing their vulnerability and susceptibility to predation.

(3) positively impact program;
Increased numbers of chinook and other salmonid species that escape to spawn in upper Columbia River tributaries may contribute nutrients to the system upon dying that would benefit summer chinook productivity.

(4) be positively impacted by program.
Summer chinook juveniles released through the WDFW programs may benefit co-occurring salmonid populations. A mass of hatchery fish migrating through an area may overwhelm established predator populations, providing a beneficial, protective effect to co-occurring wild fish. Increased numbers of hatchery-origin summer chinook that are allowed to spawn naturally may contribute nutrients to the system upon dying that would benefit the productivity of other salmonid species.

SECTION 3. WATER SOURCE

Adult summer chinook used as broodstock are captured at Dryden and Tumwater dams on the Wenatchee River, which is the home water source for the target population. Broodstock bound for the Methow and Okanogan basins are intercepted down-river at Wells Dam on the mainstem Columbia,

prior to reaching the tributaries. Broodstock trapped at the Dam and volunteering into Wells Hatchery are held in adult holding ponds supplied with water fed from the reservoir.

Captured adult fish, eggs, fry, and fingerling fish are held at Wells or Eastbank hatcheries, and reared at Eastbank Hatchery, Rocky Reach Hatchery, and Wells Hatchery. The latter three hatcheries rely on either well water (Eastbank and Wells), or water seeping below Rocky Reach Dam (Rocky Reach). Eastbank Hatchery has four wells that supply 53 cfs, varying in temperature from a low of 46°F in May to a high of 57°F in December. Water supplying Rocky Reach is 6.2 cfs of toe-drain water seeping from below the grout curtain in the earth-fill portion of rocky Reach Dam (Chapman et al. 1994). The quality of water used by the hatcheries is high, and adequate to ensure the health of salmonids propagated.

Fish reared at these hatcheries are transferred to other hatcheries (Turtle Rock) or acclimation ponds (Similkameen, Carlton, Dryden) for rearing to smolt size and release. Turtle Rock is supplied with 44 cfs of Columbia River water pumped directly from the reservoir behind Rocky Reach Dam. The rearing/acclimation ponds are supplied with river water at each site (Dryden - 16 cfs, Similkameen - 21 cfs, and Carlton - 15 cfs) and there are no differences between the water used for these latter portions of the summer chinook programs and water used by the naturally spawned populations.

SECTION 4. FACILITIES

Descriptions of the physical plants listed in this section -
Attached are plan views (from IHOT 1995) presenting the physical lay-outs of Eastbank Hatchery, Wells Hatchery, Rocky Reach Hatchery, Turtle Rock Hatchery, and the three acclimation pond sites. The Wells, Dryden, and Tumwater Dam traps are operated to collect summer chinook salmon broodstock, and to assess the status of the annual upper Columbia River Basin summer chinook return.

For programs that directly take listed fish for use as brood stock, provide detailed information on catastrophe management, including safeguards against equipment failure, water loss, flooding, disease transmission, or other events that could lead to a high mortality of listed fish -
As run-of-the-river operations, the three summer chinook broodstock trapping programs may lead to the direct take of co-migrating listed species, including Upper Columbia River ESU steelhead, Upper Columbia River ESU spring chinook, and Columbia River population segment bull trout. Direct takes of these listed species at these traps are authorized through Section 10 direct take permits #1094 (steelhead) and # 1196 (spring chinook), and under a Section 6 cooperative management agreement with the USFWS (bull trout). Risk aversion measures associated with the trapping operations are detailed in WDFW permit applications for these authorizations and within the permits themselves. No other portions of the summer chinook program are expected to lead to the direct take of listed fish.

The Wells Dam left and right bank ladder traps, and the Wells Hatchery trap, operate from early May through November to collect spring chinook, summer chinook, and steelhead broodstock. Water loss is not considered a risk factor for fish held in the traps, as the ladders are supplied with water passing through Wells Dam.

The Dryden Dam traps will be in operation 7 days per week from July 1 through mid-November each year for summer chinook broodstock collection. Water loss is not a potential risk factor, as the ladders where the fish are trapped are supplied directly by the Wenatchee River at the head of Dryden Dam.
The Tumwater Trap will be operated three days per week from early June through mid-November each year. The trap will be in active operation 16 hours per day during the three days per week that it will be open. Downstream migrating fish can pass the trapping operation freely. Frequent monitoring and operation of the trap minimizes the risk of fish loss. Water loss is not a potential risk factor, as the ladder where the fish are trapped is supplied directly by the Wenatchee River at the head of Tumwater Dam.

Describe any instance where construction or operation of the physical plant results in destruction or adverse modification of critical habitat designated for the listed species -

No circumstances where the construction or operation of the summer chinook hatchery programs result in adverse impacts to listed fish critical habitat are envisioned. The programs comply with NPDES permit effluent discharge conditions, which act to protect the quality of receiving waters adjacent to the hatcheries and acclimation ponds.

Describe any inconsistencies with standards and guidelines provided in any ESU-wide hatchery plan approved by the co-managers and NMFS -

The summer chinook production programs are fully consistent with standards and guidelines set forth in the MCMCP's "Mid-Columbia Hatchery Plan" (BAMP 1998). The plan presents hatchery programs that have been jointly developed and, in most cases, agreed to by the parties to the MCMCP, which includes WDFW, NMFS, USFWS, Chelan and Douglas PUDs, and the Tribes.

4.1) Brood stock collection

Fish traps at Wells Dam are located in the ladders on both the east and west sides of the dam. Fish reaching the top of the west side ladder ascend a 12' *Denil* fish ladder into a 12' x 12' x 8' deep holding tank. Captured fish can then be directed from the holding tank over a false weir leading to a "V" shaped chute, which funnels the fish into an underground pipe leading to a 12' x 100' pond, where broodstock are held for spawning. Movement of fish in this manner is automatic, and no handling with nets, which could damage the fish, is involved.

Adult capture traps are operated on the left and right banks of the Dryden Diversion Dam. The left bank trap is comprised of a V-weir leading into a holding tank at the top of the fish passage ladder. The area of the trap where fish are held measures 10.5' long x 8' wide, with depth varying between 6'-7', depending on river flow. The right bank trap is situated at the base of the dam. A V-weir centered in one side of a 10' x 40' x 6'-8' deep is used to capture and hold fish. From this holding area, fish are either taken for use as broodstock or shunted into a *Denil* ladder for upstream passage. The trap will operate passively 24 hours per day that it is open, and it will be checked daily for captured fish. A *Denil* ladder in the trap will be operated up to three hours per day to ensure capturing trapped fish for inclusion in the broodstock. Summer chinook retained as broodstock will be held and spawned at Eastbank Hatchery.

The Tumwater Dam trap is situated at the top of the fish ladder circumventing Tumwater Dam on the left bank of the Wenatchee River. Fish are trapped through closure of a gate at the top of the trap, which prevents upstream passage, maintaining the fish in a 10' x 50' x 8' deep holding pond. The pond lacks a "V" entry, and fish are therefore not prevented from returning to downstream areas. The trap is actively run, with fish allowed to exit the pond upstream via a *Denil* ladder shunted into a 4' x 4' holding box for immediate loading into a tanker truck for transport to Eastbank hatchery. The fish may also be passed into the dam forebay in this manner. Collected fish will be identified by species and as of wild or hatchery-origin if visible marks enable such distinguishment.

4.2) Spawning

Summer chinook trapped at Tumwater Dam and Dryden Dam are transported to Eastbank Hatchery for holding to maturity and spawning. The fish are held in an adult holding pond. Summer chinook intercepted in the Wells Dam east ladder trap are immediately transported to Eastbank hatchery and held until maturity in an adult holding pond and spawned as a separate group from the Wenatchee summer chinook. Summer chinook volunteering into the Wells Hatchery outfall trap are held to maturity and spawned for the Wells and Rocky Reach programs at Wells Hatchery. Plan views of these trapping facilities are attached.

4.3) Incubation

Eastbank Hatchery has adult holding pond space for the Wenatchee and Wells east ladder trapped fish (Methow/Okanogan) summer chinook broodstock, 70 half-stacks of vertical incubators equipped with a chilled water supply, eight 3,750 cu ft raceways and five 22,200 cu ft raceways (Chapman et al. 1994).

4.4) Rearing

Summer chinook fry are reared to fingerling size at Eastbank, Wells, and Rocky Reach hatcheries. The fish reared at Wells are released as yearlings and sub-yearlings. The fish reared at Eastbank (see above for rearing structures used) are transferred as fingerlings in the fall for overwintering at Similkameen Pond, and in the late winter or early spring to Carlton Pond and

Dryden Pond for continued rearing to yearling smolt size and spring release. Fish reared at Rocky Reach are transferred as fingerlings to Turtle Rock for continued rearing and release as either sub-yearling or yearling smolts.

4.5) Acclimation/release

Fingerlings are acclimated, reared to smolt size, and released at Wells Hatchery, Turtle Rock Hatchery, Carlton Pond, Dryden Pond, and Similkameen Pond. Plan views of these acclimation and release sites are attached. Turtle Rock Hatchery has four 400,000 cu ft rearing channels that may be used for summer chinook rearing. Each of the three acclimation sites has a single, trapezoidal pond with concrete end structures and hypalon floors and sloped sides. The volume of useable rearing space is 77,000 cu ft at Similkameen, 53,400 cu ft at Carlton, and 864,000 cu ft at Dryden.

4.6) Other

No other physical plants associated with the summer chinook artificial production programs are used.

SECTION 5. ORIGIN AND IDENTITY OF BROOD STOCK

5.1) Source

Broodstock used in the programs are collected from the run-at-large reaching Dryden and Tumwater dams on the Wenatchee system, the east ladder trap at Wells Dam, and the Wells Hatchery outfall trap on the mainstem Columbia River. These fish originated from Wenatchee River (Tumwater and Dryden traps) and Okanogan/Methow (Wells Dam traps) summer chinook populations of natural or hatchery-origin, and indigenous to those systems. Varying numbers of natural summer chinook salmon volunteer into Wells FH on an annual basis and are incorporated into the broodstock. Returning salmon from the Carlton (Methow River), Similkameen (Okanogan River), and Dryden (Wenatchee River) programs also volunteer into Wells FH, yet they are identified by CWT and can be placed into their program of origin if desired (Eltrich et al. 1995; BAMP 1998).

5.2) Supporting information

Summer chinook broodstock collected for the hatchery programs are the descendants of stock manipulations during the Grand Coulee Fish Maintenance Program and mainstem dam mitigation (Myers et al. 1998). These activities tended to homogenize extant summer chinook populations, and likely resulted in incorporation of fall-run fish into summer chinook runs under propagation. The percentage of non-indigenous stocks incorporated into the hatchery programs has been low (about 3 % of the over 200 million ocean-type chinook propagated since 1941), and does not appear to have had a significant impact on the genetic integrity of the ESU (Chapman et al. 1994; Myers et al. 1998).

5.2.1) History

Wells Hatchery - Since the initial operation of the spawning channel in 1967, broodstock collected for Wells Hatchery has come from fish diverted out of fish ladders while passing Wells Dam or from volunteers that enter the trap at the upper end of the hatchery discharge (Chapman et al. 1994). With the exception of undetected strays from other areas that may have contributed to the Wells broodstock collections, and the potential incorporation in some years (1967-86) of fall-run chinook, all broodstock for the Wells Hatchery program came from local Columbia River summer chinook stock (Chapman et al. 1994). Methow and Okanogan basin-origin summer chinook were the major populations intercepted at Wells Dam, and supplying broodstock for the program.

Rocky Reach Hatchery - Summer chinook reared at Rocky Reach, and released as smolts from Turtle Rock, are obtained from broodstock procured at Wells Dam.

Eastbank Hatchery - Broodstock supplying Eastbank's Wenatchee summer chinook program originate from indigenous fish returning to the Wenatchee River. Natural origin Wenatchee River summer chinook were trapped for the program beginning with the 1989 brood year. In accord with the Rock Island Settlement, the broodstock for the Similkameen and Carlton supplementation programs is secured by trapping Methow/Okanogan stocks at the Wells Dam east ladder. By trapping only at the east ladder, most of the returning Wells hatchery stock is avoided.

5.2.2) Annual size

The current annual program broodstock collection goals for the Eastbank hatchery's Wenatchee and Methow/Okanogan summer chinook supplementation programs are 492 and 556, respectively, equally divided by sex. Since founding the Wells summer chinook program from trapped Methow/Okanogan natural fish, there has been a transition to the use of mixed natural and hatchery-origin volunteer broodstocks at Wells Hatchery for the Wells and Rocky Reach mitigation programs. Actual collection figures for the four programs since 1989 are presented in Tables 5 and 6. Future production alternatives specified in the Mid-Columbia Hatchery Plan (BAMP 1998) will necessitate the annual collection of from 2,334 to 2,676 summer chinook (1:1 sex ratio), depending on the fate of the Rocky Reach/Turtle Rock program, to meet overall summer chinook smolt production objectives.

The collection goal of 1,048 summer chinook from the Wenatchee and Methow/Okanogan natural runs for use as broodstock is not expected to adversely affect the population status of the natural population relative to critical and viable thresholds. The use of Wells volunteer collections, consisting of mixed natural and hatchery-origin chinook, for the Wells and Rocky Reach mitigation programs is consistent with maintenance of the larger, homogenous summer/fall chinook ESU. These programs are expected to increase the population size to counter natural

bottlenecks to the productivity of the natural production system.

5.2.3) Past and proposed level of natural fish in brood stock.

Broodstock used in the summer chinook supplementation programs are secured from the run-at-large encountered through trapping in the Wenatchee River (at Tumwater and Dryden dams) and the mainstem Columbia River (Wells Dam and Wells Hatchery volunteers). There is currently no protocol in place to select either for or against any particular trait or parental origin in any of the summer chinook broodstock programs except that only Wells volunteers, which are a mix of hatchery and natural fish, are used for the Wells and Rocky Reach/Turtle Rock mitigation programs.

Table 5. Eastbank Hatchery Wenatchee summer chinook salmon broodstock collection data - 1989-1995 (data from Eltrich et al. 1995 and Petersen et al. 1999).

Brood Year	Program Goal	Actual Number Collected (adults)	Percent of Program	Sex Ratio M:F
1989	512	336	65.6	0.98 : 1.00
1990	512	84	16.4	1.03 : 1.00
1991	512	128	25.0	0.88 : 1.00
1992	512	331	64.6	0.77 : 1.00
1993	520	483	92.9	1.03 : 1.00
1994	453	423	92.1	1.00 : 1.20
1995	453	402	88.7	0.75 : 1.00

Table 6. Wells Dam and Hatchery summer chinook salmon broodstock collection data - 1989-1993 (data from Eltrich et al. 1995; Petersen et al. 1997: 1999a; 1999b; and WDFW unpublished hatchery escapement records).

Brood Year	Trapping Goal 1/	Number Trapped 2/	Total Number Collected 3/	Percent of Total Program Objectives 4/	Sex Ratio M:F 5/
1989	1,650	312	1,760	97.8	0.98 : 1.00
1990	1,061	446	1,149	63.8	1.03 : 1.00
1991	1,056	383	1,330	73.9	0.88 : 1.00
1992	677	122	740	41.1	0.77 : 1.00
1993	677	822	1,257	69.8	1.37 : 1.00
1994	700	700	2,415	134.2	0.95 : 1.00
1995	641	641	2,367	131.5	0.76 : 1.00

1/ Trapping goals reflect the number of Methow/Okanogan spawners to be intercepted at the Wells Dam fish ladders for the combined Wells and Eastbank (Methow/Okanogan) programs through 1993, and the Eastbank program only from 1994-on.
2/ Total number of upriver summer chinook broodstock trapped from Wells Dam fish ladders.
3/ Total collection number reflects upriver fish trapped at Wells Dam fish ladders plus the number of summer chinook volunteering to the Wells Hatchery outfall trap.
4/ Assumes an overall production program objective of approximately 1,800 adult broodstock plus variable jack contributions.
5/ Sex ratios for 1994 and 1995 brood years are from Wells east ladder trapped fish, not including volunteers.

5.2.4) Genetic or ecological differences

There are no known genotypic, phenotypic, or behavioral differences between the hatchery stocks and natural stocks in the target area.

5.2.5) Reasons for choosing

Summer chinook salmon propagated through the program represent the indigenous Wenatchee Basin and Methow/Okanogan populations, which are the target of the mitigation programs.

5.3) Unknowns

Run-at-large broodstock collected at Tumwater and Dryden dams, and at Wells Dam and hatchery represent the indigenous upper Columbia river summer chinook populations. Differential CWT codes would allow for separation of Eastbank (Wenatchee), Wells, Carlton, and Similkameen hatchery-origin fish that volunteer to the Wells Hatchery trap. There are no known circumstances where a lack of data would lead to uncertainties about the choice of brood stock for this part of the program.

SECTION 6. BROOD STOCK COLLECTION

The following broodstock collection practices are consistent with standards and guidelines provided in the "Mid-Columbia Hatchery Plan"assembled by the Co-managers, PUDs, and NMFS (BAMP 1998).

6.1) Prioritized goals

Current protocols for the summer chinook programs allow for the annual collection of 492 adults for the Wenatchee program, and 556 (Wells Dam east ladder) and 1,210 (Wells FH volunteers) for the Methow/Okanogan program. These adults provide gametes for the annual release of 2.36 million yearlings and 2.1 million sub-yearlings into upper Columbia Basin tributaries and the mainstem. Current broodstock collection protocols for the two programs are as follows (Petersen et al. 1999b and BAMP 1998, with reference to annual co-manager review and approval of broodstock protocols).

Wenatchee Summer Chinook Salmon -

a. Collect predominately unmarked salmon for broodstock;
b. Collect fish randomly from the run-at-large;
c. Collect no more than 25 % of the broodstock from Tumwater Dam;
d. Collect salmon throughout the duration of the run; and
e. Follow past years' protocol for operation of the inflatable bladder at Dryden Dam.

Methow/Okanogan Summer Chinook Salmon -

a. Trap no more than 20 % of the adult run, based on counts at Rocky Reach Dam:
b. If cumulative adult counts at Rocky Reach Dam are less than 40 % of the ten-year average, cease trapping until the 40 % escapement level has been reached;
c. Begin trapping after June 28 and end trapping on or before August 28;
d. Conduct trapping Sunday through Tuesday each week;
e. Do not use the west ladder on Wells Dam for broodstock collections unless difficulties are encountered with broodstock collections in the east ladder;
f. Mark all summer chinook trapped in the Wells Dam ladders to differentiate them from fish volunteering to the Wells Hatchery trap; and
g. Collect jacks in similar proportion to the run-at-large.

6.2) Supporting information

6.2.1) Proposed number of each sex.

The broodstock collection objective is to remove equal numbers of males and females.

6.2.2) Life-history stage to be collected (e.g., eggs, adults, etc.)

Adult summer chinook salmon are to be collected at Dryden Dam, Tumwater Dam, and Wells Dam and hatchery for use as broodstock.

6.2.3) Collection or sampling design.

General Objectives and Design (from BAMP 1998)-
One or more acclimation/release sites have been developed, or will be developed for summer chinook salmon on the Wenatchee, Entiat, Chelan, Methow, and Okanogan rivers (development of new sites is obviously contingent on procurement of adequate water supplies at biologically appropriate locations). A mainstem stock will be maintained for Wells FH and Rocky Reach FH (Turtle Rock) production, yet gene flow from this stock to others will be acceptable. Efforts will be made to manage these populations separately, yet it is acknowledged that straying among all populations will occur. These populations will be given strong protection against strays from outside the mid-Columbia Region, but efforts to eliminate strays from within the mid-Columbia will not be a priority. Separation and management of these populations would follow three guidelines.

a) The primary consideration is to achieve a minimum natural escapement of 2,000 adults and jacks past Wells Dam, with an emphasis on meeting the 3,500 escapement level. This goal, by far, takes precedence. The broodstock protocol (to be reviewed yearly), would provide the required direction on means to set, and meet, the yearly goal. If the run size is low in a given year, the hatchery programs will be reduced or eliminated to increase escapement. The order of elimination in hatchery programs is: (1) Wells sub-yearlings, (2) Wells yearlings, (3) the Carlton and Similkameen programs. The trap operations at the east ladder of Wells Dam may be curtailed if needed, to assist in increasing escapement.

(b) The next consideration is to ensure that those salmon intercepted from upstream migration contribute solely to upstream production. For example, volunteers at Wells Hatchery may be used for Methow and Okanogan production, but using salmon trapped at the east ladder for Wells or Rocky Reach should be discouraged, as this places upstream-bound adults significantly down-river. This principle is consistent with the first one; in low escapement years, a preponderance of volunteers can supplement the Eastbank Hatchery broodstock, allowing increased natural escapement.

(c) Marked stray salmon from programs outside the mid-Columbia would be removed from the hatchery broodstocks, when it appears that the percentage of strays from a given program exceeds 5%. This provisional standard is based upon the NMFS Biological Opinion of system wide hatchery operations in the Columbia River (NMFS 1999), and will be revised when results from ongoing region-wide analyses of genetic introgression from straying provides more definitive direction.

(d) The long-term strategy would be to transfer production from mainstem facilities (particularly Turtle Rock) to acclimation sites on tributaries (or near mainstem spawning habitat). This action would presumably further encourage local adaptation, release to adult survival, and natural productivity.

Specific Sampling and Collection Designs -
Wenatchee River -
Following are collection and sampling designs for the two trapping programs directed at summer chinook on the Wenatchee River. The 1989 - 1996 average proportion of the total return to the river collected as broodstock through these programs is 4.0 %.

Dryden Dam -
Summer chinook salmon broodstock are collected each year from the run at large reaching Dryden Dam, located at Rkm 25.8 on the Wenatchee River during the months of July and August. Chinook at Dryden, the main trapping location for the program in the river, are collected at one of two traps, located on each bank of the dam. An inflatable dam was built on the right bank sill of the dam to increase trap efficiency. When the dam is inflated, flow is displaced through the right and left fishways. The left bank trap is comprised of a V-weir leading into a holding tank at the top of the fish passage ladder. The area of the trap where fish are held measures 10.5' long x 8' wide, with depth varying between 6'-7', depending on river flow. The right bank trap is situated at the base of the dam. A V-weir centered in one side of a 10' x 40' x 6'-8' deep is used to capture and hold fish. From this holding area, fish are either taken for use as broodstock or shunted into a *Denil* ladder for upstream passage. The trap will operate passively 24 hours per day that it is open, and it will be checked daily for captured fish. A *Denil* ladder in the trap will be operated up to three hours per day to ensure upstream passage of fish released from the trap. Summer chinook retained as broodstock in accordance with the above protocols will be held and spawned at Eastbank Hatchery.

A low elevation drop at Dryden Dam allowing fish to bypass the fish ladders led to a low effectiveness in trapping broodstock in past years. Temporary modifications at Dryden Dam in 1992 were largely successful in increasing the number of fish trapped. Permanent modifications (inflatable bladder) were completed in the summer of 1992. When insufficient numbers of broodstock are captured at Dryden Dam, up to 25% of the needed broodstock can be trapped at Tumwater Dam. Unripe females are transported to Eastbank FH for holding and subsequent spawning. The fish are spawned at a 1 male to 1 female ratio; gametes of the least numerous sex are split into subsets and these are crossed with gametes from a different individual of the more numerous sex. Males are also live-spawned when necessary.

Tumwater Dam -
Summer chinook salmon broodstock are also collected each year from the run at large reaching Tumwater Dam, located at Rkm 52.0 on the Wenatchee River during the months of July and August. Fish reaching Tumwater Dam are collected using a trap positioned at the top of the fish ladder, which is located on the left bank of the river. The trap will be operated three days per week during the sockeye and steelhead collection period each year. The trap will be in active operation 16 hours per day during the three days per week that it will be open. Fish are trapped through closure of a gate at the top of the trap, which prevents upstream passage, maintaining

the fish in a 10' x 50' x 8' deep holding pond. The pond lacks a "V" entry, and fish are therefore not prevented from returning to downstream areas. The trap is actively run, with fish allowed to exit the pond upstream via a *Denil* ladder shunted into a 4' x 4' holding box for immediate loading into a tanker truck. The fish may also be passed into the dam forebay in this manner. Collected fish will be identified by species and as of wild or hatchery-origin. Summer chinook retained as broodstock in accordance with the above protocols will be held and spawned at Eastbank Hatchery.

When operating, the Tumwater Dam trap is able to collect 100 % of the summer chinook migration arriving at Tumwater Falls. The chinook have no alternatives to bypass the dam other than the fish ladder. Broodstock collection protocols dictating that no more than 25 % of the annual goal of 492 fish be taken at Tumwater minimize removal levels at this location. For example, the estimated escapement to the Wenatchee River in 1993 was 8,364 summer chinook. The collection of approximately 123 fish (25 % of 492) would lead to the removal of 1.47 % of the total estimated run.

Measures to reduce sources of bias that could lead to a non-representative sample of the desired Wenatchee River broodstock source include trapping all fish randomly from the run at large and throughout the duration of passage to ensure proportional representation of the age and size structure of the returning population. Additional measures employed to reduce the risk of adverse genetic effects to the population include a collection date beginning no earlier than July 15 to exclude spring-run chinook from the broodstock.

Adverse effects on the natural summer chinook population, and on listed fish that may be encountered incidentally during trapping, including injury during handling, behavior modification, stress, or mortality, are minimized through the following measures:

a. The Tumwater Dam trap is actively operated 16 hours per day on a three day per week schedule between early June and mid-November to directly and continuously monitor fish captures. Fish captured in the Dryden traps have shown no obvious stress and negligible pre-spawning mortality, and fish passing upstream for natural spawning are apparently not delayed to a significant extent.
b. The inflatable dam used to direct fish into the Dryden traps will be operated in a manner that does not lead to de-watering of stream areas below the dam, which could lead to stranding of fish in pocket waters. In addition, the dam will be kept inflated for the duration of any single trapping effort to minimize the likelihood for salmonid migration delays by maintaining a consistent stream flow pattern in the immediate vicinity of the dam.
c. The traps will be checked daily when it is in operation and captured fish will be removed.
d. All fish passed upstream will be enumerated by species.
e. All listed and non-listed fish not needed for authorized supplementation programs will be held

for a minimal duration in the trap and released upstream without harm.
f. The capture of adult salmon at Dryden and Tumwater dam traps does not rely on fish weirs, and all downstream migrating fish can pass the collection site freely year-round.

Methow/Okanogan Program (Wells Dam and Wells Hatchery) -
Following are collection and sampling designs for the two trapping programs directed at summer chinook at Wells Dam and Wells Hatchery. The 1985 - 1996 average proportion of the total up-river return collected as broodstock through these programs is 25.1 %.

Summer chinook salmon broodstock are collected each year from the run at large reaching Wells Dam, located at Rkm 861.0 on the Columbia River during the months of July and August. Broodstock for the Similkameen and Carlton programs are currently trapped in the fish ladders circumventing Wells Dam. Fish volunteering into Wells FH are used primarily for the Wells and Turtle Rock programs. To prevent inclusion of fall chinook population into the summer chinook gene pool, broodstock collection at both capture sites is curtailed on August 28. Ladder-trapped fish are transported to Eastbank FH where they are held until maturity and spawned. Gametes from fish with CWTs are held separately until the origin of the fish is determined. Only summer chinook salmon are used in these programs.

Fish traps at Wells Dam are located in the ladders on both the east and west sides of the dam. The ladder traps are operated from early May through November to collect spring chinook, summer chinook, and fall chinook, and steelhead broodstock for use in stock recovery and fisheries enhancement programs. Active trapping occurs 16 hours per day on a consistent schedule, and fish are removed from the traps at least daily when the traps are operational. Summer chinook broodstock are trapped each year in the east side trap, and the west side trap is only used when difficulties are encountered in securing fish from the east side trap. Fish trapped the west side ladder ascend a 12' *Denil* fish ladder into a 12' x 12' x 8' deep holding tank. Captured fish can then be directed from the holding tank over a false weir leading to a "V" shaped chute, which funnels the fish into an underground pipe leading to a 12' x 100' pond, where broodstock are held for spawning. Movement of fish in this manner is automatic, and no handling with nets which could damage the fish is involved. At the Wells east ladder trap, the fish ladder closes above a large holding area from which fish ascending a *denil* fishway and false weir are diverted via a chute directly into a truck-mounted anesthetic tank. There is no netting or other handling of fish trapped at the east ladder prior to being anesthetized, after which they can be tagged, recovered, and/or placed in transport trucks. The risk of injury to fish is minimized through application of these measures.

Measures to reduce sources of bias that could lead to a non-representative sample of the desired Methow/Okanogan basin brood stock sources include trapping all fish randomly from the run at large and throughout the duration of passage to ensure proportional representation of the age and size structure of the returning population. Additional measures employed to reduce

the risk of adverse genetic effects to the population is a collection date beginning no earlier than June 28 and ending no later than August 28 to exclude spring-run and fall-run chinook from collections. Hatchery summer chinook volunteering to the hatchery trap can be separated by origin through CWT analysis. This process will allow differentiation between Carlton, Similkameen, and Wells hatchery-origin fish (as well as out-of-basin strays) prior to spawning and maintenance of separate local broodstocks for each production area as necessary.

Adverse effects on the natural summer chinook population, and on listed fish that may be encountered incidentally during trapping, are minimized through the following measures:

a. The east ladder (and west ladder) trap(s) will be continuously monitored and operated 3 days per week during the summer chinook migration (June 28 through August 28). The east ladder trap is actively manned during trapping and the west ladder trap is passively operated and checked at least daily, ensuring minimal holding times for fish captured.
b. The Wells Hatchery trap does not incorporate a fish weir to guide fish into the hatchery fish ladder. All fish returning to Wells Hatchery recruit to the trap as volunteers. The trapping program is therefore not a "run of the river" operation, and captures of other species besides summer chinook salmon that were produced at the hatchery are minimal.
c. To minimize migration delays to fish other than the targeted species, the fish sorting flume in the west ladder trap will be staffed at all times while the fishway is barricaded for the purpose of guiding fish into the trap.
d. Attraction flows from the false weir will be maintained to encourage fish to use the sorting flume.
e. The traps will be operated in a manner to reduce retention time in the holding pools above the *Denil* fishways accessing the trap.
f. Fish not required for broodstock will be returned into the fishway as they move through the sorting flumes to continue their upstream migration.

6.2.4) Identity

(a) The target populations are the Wenatchee River and Methow/Okanogan summer chinook populations. These populations are included as part of the Upper Columbia Summer/Fall Chinook ESU (Myers et al. 1998). No other chinook population are present in the project area during the July-August broodstock collection period.
(b) Broodstock are collected from the run at large. Beginning with the 1993 brood, all summer chinook released from the Wells program have external marks (adipose clip and CWT), enabling recognition of adults upon return as of hatchery or natural origin. All yearling smolts produced by the Rocky Reach program (Turtle Rock) are adipose/CWT marked, while progress is being made toward marking all sub-yearlings (currently all "accelerated zero's are marked, but only 200,000 "normal" sub-yearlings are marked as a survival index group). All of the Wenatchee, Carlton, and Similkameen yearlings are adipose/CWT marked.
(c) Summer chinook adults recruiting to the Wells Hatchery trap are a mixture of natural and

hatchery-origin fish, and identified by CWT-adipose clip combinations. Gametes secured from these spawners are only used in the Wells Hatchery and Turtle Rock Hatchery release programs, and smolts are not released in areas above Wells Dam.

6.2.5) Holding

The Wells Dam east-ladder-trapped fish and broodstock collected as volunteers at Wells Hatchery are held to maturity in an adult holding pond at the Hatchery. Summer chinook collected at Dryden and Tumwater dams are held in an adult holding pond at Eastbank Hatchery until spawned. No takes of listed fish occur through these broodstock holding operations.

6.2.6) Disposition of carcasses

Carcasses of summer chinook spawned through the programs are buried on-site at Eastbank Hatchery or Wells Hatchery or returned to the Wenatchee, Methow, or Columbia River near the tail-race of Wells Dam for nutrient enrichment and productivity enhancement purposes.

6.3) Unknowns

A determination of whether the adult traps are capable of collecting the required number of adults that represent the demographics of the donor population with minimal injuries and stress to the fish is needed. The effects of the broodstock collection program on the timing of spawning of the target population and the on the composition of the spawning population (e.g. hatchery versus wild origin, age class distribution, sex ratios) are presently unknown, but are being determined through monitoring and evaluation projects underway.

SECTION 7. MATING

7.1) Selection method

Spawners are collected randomly from the run at large arriving at the trapping locations during the July - August summer chinook salmon migration period. Beginning (late June or early July) and ending (late August) dates set for trapping help ensure that only summer chinook salmon are used in these programs. Adult collection at Wells Dam is managed throughout the season in response to fish counts at Rocky Reach Dam to ensure adequate escapement above Wells Dam. A portion of each day's egg-take is used for on-site production at Wells Hatchery to help ensure that the hatchery broodstock remains genetically similar to, and representative of, the up-river summer chinook populations.

7.2) Males

A 1:1 mating scheme is employed. Males may be live-spawned on the first spawning day as necessary to make up for a low naturally-occurring male to female ratio. However, inclusion of jack chinook in the run-at-large broodstock collections helps to alleviate occasional low adult

male occurrence.

7.3) Fertilization

Spawning protocols reflect the need to maintain genetic diversity of the separate summer chinook populations. Summer chinook collected from the Wenatchee River and at Wells Dam are maintained at Eastbank Hatchery as separate populations and spawned at a 1 male to 1 female ratio. Gametes of the least numerous sex are split into subsets and these are crossed with gametes from a different individual of the more numerous sex. At Wells Hatchery, gametes from fish with CWTs that volunteer to the hatchery trap are held separately until the origin of the fish is determined.

Fish health procedures used for disease prevention include biological sampling of spawners. Generally, sixty ovarian fluid and kidney/spleen samples are collected from female spawners to test for the presence of viral pathogens. The enzyme-linked immunosorbent assay (ELISA) is conducted on kidney samples from 100 females. This assay detects the antigen for *Renibacterium salmonarium*, the causative agent of bacterial kidney disease (BKD).

7.4) Cryopreserved gametes

No cryopreserved gametes are used in the summer chinook programs.

7.5) Unknowns

The effects of the supplementation program on within population diversity of the summer/fall chinook ESU are not known.

SECTION 8. REARING AND INCUBATION

INCUBATION:

8.1) Number of eggs taken and survival objective to ponding

The current annual production goal for the combined programs is 2.36 million yearling smolts and 2.104 million sub-yearling smolts. Assuming a fertilization to release percent survival standard of 65.0 %, 6.87 million summer chinook eggs are needed each year for the program. The egg survival objective to the eyed stage is 92.0 % and from the eyed egg stage to ponding is 98.0 %.

8.2) Loading density

Heath stack incubators are used to incubate the summer chinook eggs at Eastbank Hatchery and Wells Hatchery. Incubation conditions at the two hatcheries are designed on loading densities

recommended by Piper et al. (1982).

8.3) Influent and effluent gas concentration

Influent and effluent gas concentrations, including dissolved oxygen concentrations, are within parameters optimal for salmonid egg and juvenile survival.

8.4) Ponding

Summer chinook fry are transferred from Heath trays for ponding upon button-up and swim-up. Ponding generally occurs after the accumulation of 1,650 to 1,750 temperature units. Unfed fry are transferred to the rearing ponds from early May through early June. The normal weight for fry initially ponded at Eastbank Hatchery for brood years 1989-95 was 0.45 grams (1000 fish per pound). The fry fork length recorded for the same brood years was 36 to 40 mm.

8.5) Fish Health monitoring

No fish disease outbreaks have been experienced during the incubation to ponding period in the summer chinook programs in recent years and mortality levels have remained within program standards. Fish health is continuously monitored in compliance with Co-manager Fish Health Policy standards (WDFW and WWTIT 1998).

REARING:

8.6) Number of fish ponded and survival objective to release

On average, 86.4 % of the summer chinook eggs fertilized through the Wenatchee program, and 84.6 % of the summer chinook eggs fertilized through the Methow/Okanogan program, survive to the fry stage for ponding (1989-92 brood year data from Eltrich et al. 1995). The program survival standard from fertilization to ponding is 90.0 %. The survival objective from fertilization to release is 65.0 %.

8.7) Density and loading.

The rearing conditions at Wells and Eastbank hatcheries (as well as its acclimation ponds) are designed on loading densities recommended by Piper et al. (1982; 6 lb/gpm and 0.75 lb/ft^3) and Banks (1994; 0.125 lb/ft^3/in) (BAMP 1998). Fry are transferred from the Heath incubation trays to fiberglass rearing tanks for start feeding, and then to raceways for continued rearing. The tanks have flow through water circulation. Fingerlings are transferred to the acclimation ponds in the tributaries in October (Carlton Ponds) and February (Dryden and Similkameen).

8.8) Influent and effluent gas concentrations

Influent and effluent gas concentrations at the hatcheries and within the acclimation ponds, including dissolved oxygen concentrations, are within parameters optimal for juvenile salmonid production and survival.

8.9) Length, weight, and condition factor.

Table 7 presents length, weight, and condition factor data for 1995 brood summer chinook reared through the Wenatchee program (from Petersen et al. 1999b). Table 8 presents the same information for fish reared for the Methow/Okanogan program.

8.10) Growth rate, energy reserves

Fish health and condition is monitored fish health professionals throughout the fingerling to smolt rearing period (ranging from ten to fifteen on-site visits per population). Summer chinook reared exhibit internal organ and body conditions that are standard for a healthy fish population. Growth samples are taken monthly at the rearing sites. Energy reserves, as indicated by results of organosomatic index sampling, are indicated in Table 9 for `95 brood summer chinook prior to release.

Table 7. Length, weight, and condition factor data for 1995 brood summer chinook reared through the Wenatchee supplementation program (Eastbank over-winter to Dryden Pond) (from Petersen et al. 1999b).

Date	Fork Length			Weight	Condition
	mm	SD	CV %	(gms)	Factor (Kfl)
June 29	44.2	2.13	4.8	0.9	1.0
Aug. 1	59.4	4.24	7.1	2.3	1.1
Sept. 1	72.1	4.30	6.0	4.1	1.1
Sept. 27	77.6	7.55	9.7	5.9	1.3
Oct. 24	93.7	8.23	8.8	9.1	1.1
Oct. 31	96.5	10.50	10.9	10.2	1.1
Nov. 30	103.5	13.54	13.1	12.9	1.2
Jan. 1	114.0	16.74	14.7	19.1	1.3
Feb. 1	123.9	24.798	20.0	25.4	1.3
Feb. 26	126.7	20.43	16.1	23.1	1.1
Feb. 28	123.3	23.59	19.1	24.4	1.3
Apr. 4	133.8	17.44	13.0	27.7	1.2
May 6	149.4	22.68	15.2	42.4	1.3

Table 8. Length, weight, and condition factor data for 1995 brood summer chinook reared through the Methow/Okanogan supplementation program (from Petersen et al. 1999b).

Date	Fork Length mm	SD	CV %	Weight (gms)	Condition Factor (Kfl)
Carlton Pond					
June 29	41.0	2.13	5.2	0.6	0.91
July 31	55.0	3.34	6.1	1.8	1.07
Aug. 30	65.5	4.31	6.6	3.2	1.13
Sept. 27	76.0	5.92	7.8	5.2	1.19
Oct. 31	91.6	7.19	7.9	7.9	1.03
Nov. 30	111.9	8.90	8.0	15.2	1.08
Jan. 1	112.2	13.61	12.1	16.8	1.07
Jan. 31	143.4	11.68	8.2	33.6	1.14
Mar 3	142.5	23.81	16.7	34.9	1.21
Mar. 18	148.5	25.09	16.9	39.9	1.22
Apr. 22	160.3	22.96	14.3	50.5	1.23
Similkameen Pond					
May 31	40.2	1.64	4.1	0.6	0.9
June 29	50.5	2.89	5.7	1.3	1.01
Aug. 1	66.8	6.18	9.3	3.6	1.2
Sept. 2	86.0	7.25	8.4	7.9	1.3
Sept. 27	105.1	8.4	8.0	15.2	1.3
Sept. 30	106.5	8.17	7.7	12.9	1.1
Oct. 31	128.5	8.61	6.7	25.4	1.2
Nov. 5	128.7	8.41	6.5	25.5	1.2
Dec. 3	133.8	9.25	6.9	27.5	1.2
Jan. 3	135.3	10.31	7.6	27.1	1.1
Feb. 4	134.6	10.07	7.5	25.2	1.0
Mar. 31	136.7	13.87	10.2	32.8	1.3

8.11) Food type and amount fed, and estimates of feed conversion efficiency.

Commercial-grade moist or semi-moist fish feed is used in the operation, and applied at sizes appropriate for the size of the fish being fed. The daily amount fed is determined by the number of fish in the population and individual fish weight. Feed is therefore applied at a daily rate ranging from 3.0 % of the total population weight per day (fry and small fingerlings) to 1.5 % of the total population weight per day for larger fingerlings. The expected feed conversion efficiency rate is 1.2.

Table 9. Results of organosomatic index (OSI) sampling conducted on 1995 brood juvenile Wenatchee and Methow/Okanogan summer chinook salmon (from Petersen et al. 1999b).

Date	Specific Indices (%) mesenteric fat	Combined Indices (%) normality	feeding	Blood Constituents Hematocrit % volume (SD)	Leucocrit (SD)	Plasma Protein g/100 ml
Wenatchee						
Feb. 26	68.8	85.5	28.3	50.70 (6.14)	0.10 (0.00)	6.28 (0.57)
Mar. 4	42.5	100.0	58.3	50.60 (5.72)	0.10 (0.00)	5.72 (0.47)
May 6	30.0	9725	75.0	47.20 (5.55)	0.33 (0.27)	4.50 (1.78)
Carlton						
Oct. 22	42.5	100.0	38.3	49.8 (5.9)	0.3 (0.2)	6.5 (1.2)
Mar. 18	65.0	92.5	33.3	45.4 (5.0)	0.1 (0.1)	5.2 (0.6)
Apr. 8	35.0	92.5	40.0	50.2 (4.1)	1.0 (0.0)	4.9 (0.8)
Apr. 22	56.3	96.0	21.7	49.8 (4.5)	0.5 (0.3)	5.4 (0.8)
Similkameen						
Sept. 27	63.8	98.5	80.7	47.8 (4.6)	0.2 (0.2)	6.7 (0.9)
Mar. 31	31.3	95.5	86.7	52.4 (7.4)	0.7 (0.2)	6.0 (0.7)

8.12) Health and disease monitoring.

Fish health and disease condition are continuously monitored in compliance with Co-manager Fish Health Policy standards (WDFW and WWTIT 1998). Fish health and condition is monitored on-site by fish health professionals at the summer chinook rearing locations ten to fifteen times during the freshwater rearing period. In particular, summer chinook are screened prior to transfer and again at release for the incidence of bacterial kidney disease (BKD) through the ELISA process. Results of ELISA testing of `95 brood summer chinook indicate that the prevalence of BKD in the Wenatchee population was very low. The prevalence of BKD in the `95 brood Carlton Pond population was higher than the Similkameen Pond population. The `95 brood Carlton Program failed to meet the numerical release objective because of a BKD outbreak at Methow Hatchery, from which the smolts were transferred. The results of fish health monitoring for the summer chinook programs are presented each year in WDFW Rock Island Fish Hatchery Complex annual reports.

8.13) Smolt development indices, if applicable:

Degree of smoltification is monitored through monthly collection of data indicating average condition factor (Kfl) of the populations (see Tables 7 and 8). Gill ATPase levels have been monitored in the past to attempt to indicate degree of smoltification. However, this index has not been found to be a useful tool for determining when to begin releases, due to the delay in obtaining results from sampling, and the finding that ATPase levels do not actually increase until the smolts are actively migrating in the Columbia River (Petersen et al. 1999b)

8.14) Use of "natural" rearing methods:

"Natural" rearing methods are approached through the transfer of most summer chinook smolts to acclimation ponds at release locations. The trapizoidal, hypalon-lined ponds provide a lower density rearing location for the fish on their "home" water. The ponds therefore provide a more natural setting for the populations than if the fish were retained in concrete raceways, and released at central locations or scatter-planted to the upper river tributaries.

8.15) Unknowns

Monitoring and evaluation measures are proposed to address data gaps that lead to uncertainty in the incubation and rearing protocols. These uncertainties include whether the release of ocean-type chinook salmon into the tributaries, areas of significant natural production, impose deleterious ecological effects upon natural fish are of concern. Natural summer chinook in the region are ocean-type populations, and the release of yearling fish through the hatchery programs, an out-migration strategy that differs from the natural population, is of concern. Whether the increasing incidence of "reservoir-reared" juveniles (Petersen and Murdoch 1998) in the natural population is related to the effects of hatchery practices or simply due to hydroelectric impoundments delaying sub-yearling migrations is presently unknown. Unknowns of this yearling release strategy include: the demographic aspects of returning hatchery adults originating from yearling releases; the potential for genetic changes from the natural population from differing selective processes on yearlings versus sub-yearlings; and, the effects of hatchery yearling releases upon natural juveniles.

Carefully developed hatchery operation and evaluation programs, such as those developed for the Rock Island Hatchery Complex (RIHC), will be a component of the Mid-Columbia Hatchery Program (BAMP 1998) to identify the hazard of each hatchery program to the listed species, and the means to quantify this risk.

SECTION 9. RELEASE

9.1) Life history stage, size, and age at release: (from BAMP 1998)

In the Columbia River, ocean-type chinook salmon released as yearlings have consistently survived better than those released as sub-yearlings In the Columbia River, the benefits of rearing juveniles through a yearling stage include (1) improved passage through hydroelectric

dams, through coincidental timing of releases with increased flows and spill (Raymond 1988); (2) better fish guidance efficiency of yearlings at the dams because of behavioral and buoyancy changes (Giorgi et al. 1988); (3) decreased susceptibility to predators (Poe et al. 1991); and (4) improved swimming performance of larger smolts (Park 1969). Based upon smolt production numbers to necessary to achieve hatchery compensation objectives, the difference in production required between yearling and sub-yearling ocean-type chinook salmon is on the order of 0.24. In other words, for every 1,000 sub-yearling summer chinook smolts to be produced for compensation, 240 yearling smolts could be produced in lieu of the sub-yearlings. This ratio was derived from observed differences in survival between yearling and sub-yearling releases from Wells FH. The appropriate mix of yearling and sub-yearling smolts has been evaluated through the "Mid Columbia Hatchery Plan" to minimize the risk of this increased hatchery production on the existing natural production. At this time, hatcheries release ocean-type chinook salmon at both ages. Fish from the two rearing strategies encounter different selective processes (such as downstream migration conditions and ocean distribution), yet the demographic characteristics of those salmon released as yearlings have not meaningfully deviated from that of naturally-produced fish, particularly in light of recent findings of "reservoir-reared" natural smolts. However, the demographic characteristics of the fish reared as yearlings will continue to be monitored, to ensure adaptability of hatchery fish to natural conditions. Demographic characteristics to be monitored will include, but not be limited to release to adult survival, age at return, length at age, sex ratio, and fecundity/length relation.

The current production goals for Wells FH are to release 484,000 sub-yearlings at 20 fpp, and 320,000 yearlings at 10 fpp. The current production goals for Eastbank FH include 400,000 yearlings for release from Carlton at 10 fpp, and 576,000 yearlings for release from Similkameen at 10 fpp.

9.2) Life history stage, size and age of natural fish of same species in release area at time of release.

Natural sub-yearling fry spend a few days to several months in areas from which they emerged. Snorkel observations on the Wenatchee River indicate that ocean-type chinook salmon emergence occurs from mid-February to the end of April, and many move downstream to the mainstem Columbia River during their first year. Most probably depart from tributaries by mid-July (Chapman et al. 1994). Natural fish emerge at a size of 39 - 41 mm fl, based on size ranges recorded for swim-up fish in the WDFW hatcheries rearing summer chinook. Hillman and Chapman (1989) reported that chinook in the Wenatchee River in 1986 increased in mean fork length from 48 mm in June to 84 mm. In 1987, chinook increased in mean size from 70 mm in July to 79 mm in October. Given the April-May and June release timing for hatchery yearling and sub-yearling fish, respectively, the hatchery fish may encounter natural-origin fish in the tributaries and upper Columbia mainstem ranging in size from 40 mm to around 50 mm. Relatively large yearling hatchery fish recently released from acclimation ponds may interact with recently-emerged natural fish. Their habitat uses would probably differ, because of size-specific

habitat and forage needs (BAMP 1998).

9.3) Dates of release and release protocols.

Wenatchee River summer chinook are released as yearlings from Dryden Pond in late April or early May. Summer chinook yearlings are released from Carlton Pond in mid- to late April. Similkameen Pond fish are released as yearlings in late March or early April. Wells Hatchery yearlings are released in April and sub-yearlings are released in June. Turtle Rock yearlings and sub-yearlings are also released in April and June, respectively.

The summer chinook programs place increased emphasis on release of ocean-type chinook salmon into the tributaries--areas of significant natural production. Because of this, deleterious ecological effects upon natural fish are of concern. Hatchery strategies that minimize risk to natural populations will be used. These strategies include, but are not limited to, protracted volitional releases, and acclimation on river water.

9.4) Location(s) or release.

Summer chinook produced through the programs are released at the following locations:

Table 10. Release locations by age class for summer chinook salmon produced through WDFW hatchery programs in the Upper Columbia River region.

Release Location	Watershed	Age class	WRIA # / Rkm
Dryden Pond	Wenatchee R.	Yearling	45-0030 / 25.8
Carlton Pond	Methow River	Yearling	48-0007 / 59.0
Similkameen Pond	Similkameen R (Okanogan)	Yearling	49-0325 / 33.8
Wells Hatchery	Columbia R.	Yearling	48-0001 / 861.0
	"	Sub-yearling	"
Turtle Rock Hatchery	Columbia R.	Yearling	48-0001 / 793.0
	"	Sub-yearling	"

9.5) Acclimation procedures.

Summer chinook are transferred as fingerlings or sub-yearlings to acclimation ponds in the Wenatchee, Methow, and Similkameen drainages in the fall (September or October) or late winter (February or March) to acclimate and imprint the fish to the desired up-river return locations. Past years' releases of Wenatchee summer chinook yearlings have wintered at Eastbank Hatchery on well water and have had a relatively short acclimation period on Wenatchee River water at Dryden Pond (60 to 74 days) (Petersen et al. 1999b). Starting with the 1995 brood, an attempt was made to move a proportion of the Eastbank fish to the Wenatchee watershed (Chiwawa Ponds) in the fall for an additional four months of acclimation. The effects of this additional acclimation period on the contribution of hatchery-origin summer chinook to adult returns is being evaluated. Brood year 1995 summer chinook programmed for

Carlton Pond were also transferred both in the fall and in the late winter to the Methow watershed for acclimation. Similkameen Pond received `95 brood summer chinook fingerlings in the fall, for six months of acclimation in the Similkameen River Basin, and release of yearling fish in late March.

Summer chinook yearlings and sub-yearlings produced at Wells Hatchery are reared entirely at the hatchery and fully acclimated to the release site. Yearlings and sub-yearlings released from Turtle Rock Hatchery are transferred from Rocky Reach Hatchery in November (yearlings) for six months of acclimation (April release), and in April-May (sub-yearlings) for three months of acclimation (June-July release). Adult capture facilities are available for the Rocky Reach/Turtle Rock programs, but they are not currently used. Future plans call for collection of Turtle Rock fish at the hatcheries, but on the short term, broodstock for the programs is secured from Wells Hatchery volunteers. The long-term strategy is to transfer production from Turtle Rock to acclimation sites on tributaries (or near mainstem spawning habitat). This action would presumably further encourage local adaptation and natural productivity (BAMP 1998).

9.6) Number of fish released:

Table 11 presents WDFW hatchery summer chinook salmon yearling smolt production data for brood years 1989 through 1996 releases from Dryden Pond in the Wenatchee Basin.

Table 11. Summer chinook salmon yearling smolt release data for the WDFW Dryden Pond hatchery program in the Wenatchee River Basin - brood years 1989-96 (data from Petersen et al. 1999b and WDFW Hatcheries Program database, September 29, 1999).

Brood Year	Date(s) Planted	Number Released	Kg Released	Average Size at Release (gms)
1989	Apr. 19 - May 24, 1991	720,000	13,370	45.4
1990	Apr. 15 - May 22, 1992	124,440	5,644	45.4
1991	Apr. 22 - May 25, 1993	191,179	8,105	42.2
1992	Apr. 21 - May 24, 1994	627,331	27,662	44.5
1993	Apr. 15 - May 17, 1995	900,429	32,271	34.9
1994	Apr. 18 - June 4, 1996	797,350	36,043	37.8
1995	May 8, 1997	687,439	29,142	42.4
1996	April 28, 1998	600,127	25,925	43.2

Tables 12 and 13 present yearling and sub-yearling production data for the same brood year

range from the Methow/Okanogan and Wells Hatchery/Turtle Rock Hatchery release programs, respectively.

Table 12. Summer chinook salmon yearling smolt release data for the WDFW Carlton Pond (Methow) and Similkameen Pond (Okanogan) hatchery programs - brood years 1989-96 (data from Petersen et al. 1999b and WDFW Hatcheries Program database, September 29, 1999).

Brood Year	Release Site	Date(s) Planted	Number Released	Kg Released	Average Size at Release (gms)
1989	Carlton Similkameen	Apr. 23 - May 20, 1991 Apr. 26 - May 21, 1991	420,000 352,600	19,047 14,539	45.4 41.2
1990	Carlton Similkameen	Apr. 14 - May 8, 1992 Apr. 23 - May 20, 1992	391,650 540,000	13,665 20,487	34.9 37.8
1991	Carlton Similkameen	Apr. 5 - May 12, 1993 Apr. 8 - Apr. 9, 1993	540,900 675,500	24,535 15,321	45.4 22.7
1992	Carlton Similkameen	Apr. 21 - Apr. 22, 1994 Mar. 24 - Apr. 7, 1994	402,641 548,182	14,199 13,813	35.1 25.2
1993	Carlton Similkameen	Apr. 24 - May 11, 1995 April 1, 1995	433,375 586,000	15,274 ~20,451	35.1 34.9
1994	Carlton Similkameen	Apr. 26 - Apr. 30, 1996 Mar. 21 - Apr. 23, 1996	406,560 536,299	~14,270 ~14,309	35.1 26.7
1995	Carlton/Methow Similkameen	Apr. 8, Apr. 20 1997 March 1, 1997	353,182 587,000	15,508 19,294	32.4, 50.5 32.8
1996	Carlton Similkameen	April 14, 1998 March 13, 1998	298,844 507,913	13,556 13,016	45.3 25.6

9.7) Marks used to identify hatchery adults.

Nearly all summer chinook produced through the WDFW programs in the region are marked with an adipose clip/coded wire tag combination to allow for visual identification of hatchery-origin fish upon adult return, differentiation of hatchery fish from wild fish and from hatchery fish from the various release locations, and assessment of brood year fishery contribution and survival rates by release site. While the intent (BAMP 1998) is to adipose clip/CWT mark all summer chinook production lots, the Turtle Rock “normal” sub-yearlings presently are only represented by a 200,000 fish marked index group.

9.8) Unknowns

Uncertainties pertaining to release strategies applied through the program that should be resolved to allow for adaptive management include the following: (1) the effect of broodstock collection on natural escapement levels, (2) the demographic aspects of returning hatchery adults, (3) the potential for genetic changes from the natural population from differing selective processes on yearlings versus sub-yearlings, and (4) the effects of hatchery releases upon natural juveniles, including incidental take effects on listed fish..

Table 13. Summer chinook salmon yearling and sub-yearling smolt release data for the WDFW Wells Hatchery and Turtle Rock Hatchery programs - brood years 1989-96 (data from WDFW Hatcheries Program database, September 29, 1999).

Brood Year	Age Class	Date(s) Planted	Number Released	Kg Released	Average Size at Release (gms)
Wells Hatchery					
1989	Yearlings Sub-yearlings	- May 25, July 20, 1990	- 1,521,129	- 16,814	- 11.1
1990	Yearlings Sub-yearlings	April 27, 1992 June 8, June 24, 1991	371,369 765,693	21,056 15,142	56.7 19.8
1991	Yearlings Sub-yearlings	April 16, 1993 Jan. 21 - June 22, 1992	392,330 858,000	11,864 10,884	30.2 12.7
1992	Yearlings Sub-yearlings	April 27, 1994 -	331,353 -	12,525 -	37.8 -
1993	Yearlings Sub-yearlings	Apr. 15 - Apr. 30, 1995 June 28, 1994	388,248 187,382	21,297 3,148	54.9 16.8
1994	Yearlings Sub-yearlings	Apr. 1 - Apr. 9, 1996 June 15-26, Sept. 8, 1995	365,000 491,735	17,427 6,936	47.7 14.1
1995	Yearlings Sub-yearlings	Apr. 1 - Apr. 18, 1997 June 13-15, Aug. 7, 1996	290,000 500,000	15,224 11,196	52.5 22.4
1996	Yearlings Sub-yearlings	Apr. 15-24, 1998 June 18-25, Aug. 7, 1997	348,559 575,411	21,080 13,551	60.5 23.6
Turtle Rock Hatchery					
1995	Yearlings Sub-yearlings	April 17, 1997 June 27 - June 28, 1996	150,000 1,243,600	9,072 18,130	60.5 14.6
1996	Yearlings Sub-yearlings	Apr. 15 - May 5, 1998 June 30, 1997	202,727 862,515	13,604 9,525	67.1 11.0

SECTION 10. MONITORING AND EVALUATION OF PERFORMANCE INDICATORS

Staffing, and other support logistics for the upper Columbia River summer chinook production programs are provided by WDFW. Funding for the programs is provided by PUD No. 1 of Chelan County and PUD No.1 of Douglas County for the purpose of mitigation for lost fish production associated with hydroelectric power system development in the region. Staffing and funding are available and committed to allow at least partial implementation of data collection, and monitoring and evaluation, described in this section. Presently there is no formally funded monitoring and evaluation program for the Rocky Reach/Turtle Rock program (Chelan PUD), and only recent agreement with Douglas PUD to begin monitoring and evaluation of the Wells summer chinook program.

10.1) Marking

As mentioned previously, all summer chinook smolts, except the Rocky Reach/Turtle Rock sub-yearlings (200K index group), produced through the programs are marked with an adipose clip/coded wire tag combination. No natural-origin fish are proposed to be marked at this time.

10.2) Genetic data

The ocean-type chinook salmon in the mid-Columbia Region is one of the most electrophoretically homogenous populations in the state (BAMP 1998). Ocean-type chinook in the region are genetically distinct from lower Columbia River ocean-type populations (Myers et al. 1998). Hatchery manipulations post-GCFMP, and in recent years, have lead to the mixing of summer chinook from various parts within the upper Columbia River region (Chapman et al. 1994). This mixing, and/or homogenization that occurred through the GCFMP, may be responsible for the inability of electrophoretic analysis to differentiate among components of the Upper Columbia River summer/fall chinook ESU (Chapman et al. 1994). A thorough review of available genetic studies of Pacific Northwest chinook salmon populations, and presentation of baseline genetic data for the Upper Columbia summer/fall chinook salmon ESU, is included in the NMFS BRT chinook salmon status review document (Myers et al. 1998).

10.3) Survival and fecundity

10.3.1) Average fecundity

Fecundity will be monitored through sub-sampling throughout the collection season of individual egg weights applied to the weight of green eggs taken from returning spawners and the total number of females spawned. Summer chinook females returning to Wells Dam in 1978-82 had a mean fecundity of 4,935 (Chapman et al. 1994). Mean fecundity calculated for Methow summer chinook were 2,284 for 4-year-olds, 4,306 for 5-year-olds, and 4,980 for 6-year-olds (Chapman et al. 1994). The program fecundity goal is the brood year average level.

10.3.2) Survival

a) Collection to spawning

Summer chinook adult losses during trapping and holding will be monitored through removal and enumeration of mortalities in the Dryden Dam and Tumwater Dam traps and at the Wells Dam and Well Hatchery traps. Mortality will also be monitored during broodstock holding for adult Wenatchee River-origin fish transferred to Eastbank Hatchery for spawning. The survival standards for the programs are 80.0 % (pre-spawn) and 98.0 % (females to spawning) (Petersen et al. 1999b).

b) Green eggs to eyed eggs

Egg losses during incubation monitored through removal and enumeration of green egg mortalities upon shocking from Heath trays at Eastbank and Wells hatcheries. The green to eyed egg survival standard for the program is 92.0 % (Petersen et al. 1997).

c) Eyed eggs to release

Eyed egg and juvenile fish losses during incubation and rearing will be monitored through removal and enumeration of eyed egg mortalities from Heath trays at Eastbank and Wells hatcheries, and daily or weekly (as necessary) removal and enumeration of fish mortalities occurring during the three to twelve month rearing periods at the hatchery and acclimation pond rearing locations. The following survival standards for the program will be pursued during the eyed egg to release phases of the supplementation program (taken from Petersen et al. 1999b):

Table 14. Survival standards for the WDFW Upper Columbia River summer chinook hatchery programs.

Production Phase	Survival Standard (%)
Eyed egg to ponding	98.0
30 days post ponding	97.0
100 days post ponding	93.0

Production Phase	Survival Standard (%)
Ponding to smolt	72.0

d) Release to adult, to include contribution to:

(i) harvest

Contribution of WDFW hatchery program-origin summer chinook salmon to fisheries in the mainstem Columbia River and within the tributaries will be monitored and evaluated through the regional coded wire tag recovery and evaluation program implemented by WDFW, the Tribes, and other fisheries management agencies in the Columbia Basin. Nearly all summer chinook produced through the WDFW programs in the region are marked with an adipose clip/coded wire tag combination to allow for visual identification of hatchery-origin summer chinook upon capture, and evaluation of their origin through the existing coded wire tag recovery and evaluation programs.

(ii) hatchery brood stock

Contribution of program-origin fish to the hatchery broodstock will be monitored and controlled through visual identification of adipose-clipped hatchery fish upon capture at Tumwater Dam. Gametes from hatchery fish volunteering to the Wells Hatchery trap can be segregated and incubated separately to allow for determination of release origin (Carlton, Similkameen, Wells Hatchery, or Turtle Rock) and allocation of resultant progeny to the appropriate rearing sites. Numbers of proportions of program-origin summer chinook relative to unmarked natural-origin fish arriving at the three trapping locations will be monitored and evaluated in this manner.

(iii) natural spawning

A stream survey and carcass recovery program implemented by WDFW on the Methow, Wenatchee, and Okanogan/Similkameen rivers allows for the evaluation of the contribution of hatchery-origin summer chinook adults to the annual naturally spawning population. Foot and float surveys are conducted weekly on the tributaries during the summer/fall chinook spawning period to enumerate spawners and to identify the origin of spawned-out carcasses through examination for marks. Takes of listed steelhead associated with these surveys are authorized through an approved modification of Section 10 direct take permit # 1094, issued to WDFW by NMFS on April 8, 1998.

10.4) Monitoring of performance indicators in Section 1.8

The following monitoring objectives measures are included in the Mid-Columbia Hatchery Plan (BAMP 1998) to evaluate the performance of the summer chinook salmon supplementation programs. These measures are either being presently applied through the WDFW program, or in need of further funding to fully implement them. From BAMP (1998):

Monitoring and Evaluation Objectives:

Objective 1: Determine if the summer chinook hatchery facilities are capable of meeting the current production objectives.

Objective 2: Determine whether the survival from release-to-adult of summer chinook produced by the facilities is sufficient to achieve the number of adults needed to compensate for lost production due to hydroelectric project development.

Objective 3: Determine if actions taken to produce summer chinook salmon conserve the reproductive success, genetic integrity, and long-term fitness of natural spawning summer/fall chinook populations of salmon in the region.

Objective 4: Determine whether smolts released from the rearing and acclimation facilities disperse and migrate downstream without impacting the natural population.

Monitoring and evaluation tasks that should be completed to meet the above objectives:

Objective 1: Determine if the summer chinook hatchery facilities are capable of meeting the current production objectives.

Task 1-1: Determine the pre-spawning and egg-to-release survivals of fish for each population at various life stages at central rearing and acclimation ponds.

1) Monitor growth, mortality rates, and feed conversion of yearling summer and fall chinook salmon reared at the Mid-Columbia central rearing and acclimation sites.

2) Determine egg-to-fry and fry-to-smolt survival rates for summer and fall chinook salmon.

3) Maintain and compile records of cultural techniques for each life stage, such as: number of times adults handled for observation and inoculation; fish and egg condition at time of spawning; ponding, densities at splits and outplanting, feeding schedule of juveniles, and transport loading densities, tempering, and conditions.

4) Summarize results of tasks for presentation in annual and monthly reports. Make recommendations for improved smolt production at listed facilities. Any problems with operation of the facilities will also be noted.

Task 1-2: Determine if the adult traps are capable of collecting the required number of adults that represent the demographics of the donor population with minimal injuries and stress to the fish.

1) Monitor operation of adult traps in Wenatchee River at Dryden and Tumwater, and at Wells Dam. Additional traps that may be built under the Mid-Columbia Hatchery Program will be monitored. Ensure compliance with established broodstock collection protocols for that station.

2) Monitor timing, duration, composition and magnitude of the runs at adult collection sites.

3) Maintain daily records of trap operation and maintenance, number and condition of fish trapped, and river stage. If low collection rates are a problem, trap data will be compared with fishway operations and flow data.

4) Collect biological information on trap-related mortalities. Determine, if possible, causes of mortality. If possible, use carcasses for stock profile sampling.

5) Summarize results for presentation in annual report. Provide recommendations on means to improve adult trapping, and if needed, refinements to broodstock collection protocols for each population.

Task 1-3: Monitor fish health, specifically as related to cultural practices that can be adapted to prevent fish health problems.

1) Standard hatchery fish health monitoring will be conducted (minimum of monthly checks of salmon and periodic checks of steelhead) by fish health specialist, with intensified efforts to monitor presence of specific pathogens that are known to occur in the donor populations. Significant fish mortality to unknown cause(s) will be sampled for histopathological study.

2) Incidence of viral pathogens in salmon and steelhead broodstock will be determined by sampling fish at spawning in accordance with the Salmonid Disease Control Policy of the Fisheries Co-Managers of Washington State (WDFW and WWTIT 1998). Populations of particular concern may be sampled at the 100% level and may require segregation of eggs/progeny in early incubation or rearing.

3) Incidence of *Renibacterium salmonarium* (Rs, causative agent of bacterial kidney disease) in salmon broodstock will also be determined by sampling fish at spawning. Broodstock will be sampled for enzyme-linked immunosorbent assay (ELISA).

4) If required, provide recommendations to hatchery staff on means to segregate eggs/progeny based on levels of Rs antigen, protecting "low/negative" progeny from the potential horizontal transmission of Rs bacteria from "high" progeny. Progeny of any segregation study will also be tested by ELISA; at a minimum each segregation group would be sampled at release.

5) Use ELISA monitoring to help determine efficacy of gallimycin treatments to juveniles.

6) Autopsy-based condition assessments (OSI) will be used to assess hatchery-reared salmon smolts at release. If needed, perform OSI assessments at other key times during hatchery rearing.

7) Provide recommendations on fish cultural practices and satellite stations on monthly basis. Summarize results for presentation in annual report.

Objective 2: Determine whether the release-to-adult survival of fish from the Mid-Columbia Hatchery Program is sufficient to achieve the Phase A production objective (Table 17).

Task 2-1: Estimate the harvest contribution and escapement to the mid-Columbia summer and fall chinook salmon released from Mid-Columbia hatcheries.

1) Compile CWT recovery data from hatchery releases. Provide summary of ocean distribution, contribution, and survival, if such information is available.

2) Recover heads from marked (adipose clipped) returns to mid-Columbia FH facilities during routine spawning operations.

3) Recover heads from marked salmon carcasses during routine stream work.

4) Summarize results for presentation in annual report.

Objective 3: Determine if actions taken under Mid-Columbia Hatchery Program conserve the reproductive success, genetic integrity, and long-term fitness of natural spawning populations of salmon in the Mid-Columbia Region.

Task 3-1: Monitor the hatchery broodstock (and resultant progeny) for evidence of introgression of foreign genes, accelerated genetic drift or loss of genetic variation in the donor populations that could be caused by the hatchery program. Monitor populations in supplemented streams to establish baseline genetic stock identification profiles.

1) Develop a broodstock monitoring program for electrophoretic analysis of allele frequency variation at selected monomorphic and polymorphic loci. Collect tissue samples from each study group for electrophoretic analysis, using methods defined by Coastwide Consortium.

2) Collect tissue samples from summer chinook salmon that enter Wells Dam adult trap, Wells FH, Dryden Dam, Tumwater Dam, and other trap locations developed in the Mid-Columbia

Hatchery Program.

3) Prior to release, collect tissue samples of representative juveniles for electrophoretic analysis, using methods defined by Coastwide Consortium. Compare genetic diversity of progeny samples to founder samples.

4) Begin archival of samples for potential DNA analysis in the future.

5) Collect and process adults from all study groups for scale sampling. Sample sizes for other populations will follow standard guidelines set by WDFW for variable escapement.

6) Take lengths of returning adults of all study groups, and determine sex ratios. Determine fecundity of females, and average egg size.

7) Provide results in annual report, or at appropriate time. If necessary, give recommendations for broodstock collections for study groups.

Task 3-2: Determine stray rates of fish released from Mid-Columbia hatcheries into other streams and facilities on the mid-Columbia River.

1) Conduct summer chinook carcass surveys for marked fish on the spawning areas of the Similkameen River, lower Okanogan River, and mainstem Methow River. Coordinate activities with fishery management entities undertaking spawning ground surveys.

2) Determine incidence of marked fish released from one facility in recoveries at other hatcheries in the Mid-Columbia Region. Coordinate activities with hatchery managers.

Task 3-3: Mark each population subjected to ocean fisheries or mainstem Columbia River commercial or tribal fisheries with sufficient CWTs to estimate harvest contribution.

1) Mark (Ad + CWT) and release summer chinook salmon for determination of survival, ocean distribution, contribution to various fisheries, and returns to Columbia River sampling stations.

2) Place an external mark on selected production groups to allow recognition during broodstock collection.

3) Determine the statistical requirements to provide reliable estimates of escapement and harvest contribution. Determine the number of CWTs and other marks needed in relation to the number of recoveries expected.

4) If necessary, begin coordination of large-scale sampling program for CWT recoveries at

hydroelectric projects, and on spawning grounds.

Task 3-4: Conduct intensive spawning and carcass surveys for summer chinook on all streams in the Mid-Columbia Region that support ocean-type chinook salmon.

1) Document location and number of naturally spawning spring and summer chinook salmon in these rivers. Conduct redd counts, determine spawner density, and evaluate locations of preferred areas. Determine distribution of redds by river kilometer.

2) Define annual and long-term changes in the spawning distribution of salmon in these rivers.

3) Determine if hatchery-reared adults reproduce effectively in terms of distribution with the naturally produced spawners, timing, and utilization of habitat.

Task 3-5: Begin baseline data collection for determination of Natural Cohort Replacement Rate for selected populations.

1) Enumerate escapement of marked and unmarked salmon to one or more streams. Randomly collect broodstock, as defined in the collection protocol. Estimate total number of spawners in those streams.

2) Use salmon collected for broodstock as random sample of returning population. Collect scales to determine age.

3) Use known age structure, fecundity, and sex ratio of collected adults to estimate egg deposition to those streams. Determine egg retention of marked and unmarked fish by opening carcasses of females during spawning ground surveys. Adjust estimate accordingly.

4) Develop methods for a long-term comparison of total spawner number to number of donor adults taken for broodstock.

5) Summarize results for presentation in annual report. Provide detailed description of methods for long-term analysis of natural cohort replacement ratios.

Objective 4: Determine whether smolts released from the rearing and acclimation facilities disperse and migrate downstream without impacting the natural population.

Task 4-1: Monitor fish behavior and emigration rates from the rearing/ acclimation ponds.

1) Install volitional fish counters (or PIT tag detectors) at outfalls to selected acclimation ponds.

2) Evaluate condition of summer and fall chinook salmon from satellite facilities prior to release. Evaluate smolt quality though OSI analysis, determine sexual precocity, descaling rates, condition factors.

3) Evaluate degree of smoltification at release site. Compare this information to environmental factors (water temperatures, river flows) at time of release.

4) Assess downstream migrants within migration corridor for degree of smoltification. If possible, identify fish to determine stock and release site. Determine trend in parr/smolt transformation in actively migrating smolts given a volitional and forced release.

Task 4-2: Develop a plan to observe fish behavior below and above the discharge at selected rearing/acclimation ponds.

10.5) Unknowns or uncertainties identified in Sections 5 through 9

Unknowns and uncertainties identified in previous sections will be addressed through monitoring and evaluation measures proposed above in Section 10.4.

10.6) Other relevant monitoring projects

WDFW's smolt monitoring program at Rock Island Dam, and other smolt passage monitoring programs operating in the mainstem Columbia River, will contribute additional information regarding the passage timing and survival of summer chinook produced each year through the supplementation programs.

SECTION 11. RESEARCH

Research programs associated with this HGMP are described within the monitoring and evaluation sections above. Research will be directed at determination of supplementation program contribution rates, the ecological and genetic effects of the program on the natural population.

SECTION 12. ATTACHMENTS AND CITATIONS

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